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ANALYSIS OF PERFORMANCE AND EMISSION PARAMETERS OF METHYL ESTERS OF COCONUT OIL AND EUCALYPTUS OIL BLENDS IN VCR-CI ENGINE

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ABSTRACT

With the increasing consumption of fossil fuels along with the increasing number of automobiles, there is a definite need for finding a proper replacement for fossil fuels which should also be environmentally friendly & renewable in nature. Because of the dominant role of CI engine in day-to-day life, the paper focuses exclusively on the research of alternative fuels for the CI engine. Blends of eucalyptus oil and coconut oil have been selected exclusively as a complete replacement of diesel in a variable compression ratio (VCR) engine. Coconut oil cannot be directly used as a fuel in CI engine due to its high FFA content. Thus, two stages of transesterification are done followed by water washing. Acetone is used as fuel additive Performance and emission parameters of five fuels, namely Diesel, (C70+E30), (C80+E20), (C90+E10) and (C90+E10+ADD) have been studied at two compression ratios of 16 & 18. (C90+E10+ADD) blend at a compression ratio of 18 shows better performance and lower emissions when compared to other fuels and compression ratios.

***KEYWORDS**: Coconut Oil, Compression Ratio, Eucalyptus Oil, Emission & Performance*

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Original Article

INTRODUCTION

Eucalyptus oil has a high calorific value, closer to diesel. But it cannot be used as a fuel because of its lower performance and combustion characteristics due to lower cetane number. Thus Coconut oil is used here as a performance enhancer. The blend of methyl ester of Coconut oil and Eucalyptus oil has been used as a fuel and is compared to diesel, to evaluate whether it can be used as a replacement for diesel or not.

Coconut Oil

Coconut oil is an edible oil extracted from the kernel or meat of matured coconuts harvested from the coconut palm (cocos-nucifera). It has various applications in food, medicine, and industry. Because of its high saturated fat content, it is slow to oxidize and thus, resistant to acidification, lasting up to two years without spoiling. Many healthy organizations advise against the consumption of high amounts of coconut oil due to its high levels of saturated fat. Coconut oil can be extracted through "dry" or "wet" processing. The crude oil is then refined, hydrogenated & fractioned to make it suitable to use.

Eucalyptus Oil

Eucalyptus Oil is the distilled oil from Eucalyptus leaf, a genus of plant family Myratceae origin of Australia and with worldwide cultivation. It is being widely used as an antiseptic pharmaceutical, repellent, fragrance, flavoring,

and industrial uses. The tree is grown in the waterlogged lands consuming excess water, avoiding the water from swamps where the malaria mosquito may be residing.

Acetone as Fuel Additive

Acetone has been known as a fuel additive from a long time for SI engines. They have been used as a fuel additive in racing cars for increasing the combustion & performance of the engine. In recent times, the study of acetone additive in diesel engines has been conducted, but in smaller amounts of addition.

MATERIALS AND METHODS

Extraction of Eucalyptus Oil

The eucalyptus leaves are crushed ever so slightly using fingers, releasing the essential oils. Oil and leaves are mixed together in a large crock pot. 1/4 oz. of leaves are used for every 1 cup of oil. The crockpot is set on low and the mixture is cooked for at least six hours. Alternatively, the leaves and oil are mixed in a mason jar and left in the sun for two weeks. Oil is strained using a cheesecloth after the time has elapsed (either six hours or two weeks). Oil is poured into a clean mason jar, labeled with the contents and the date it was created, and stored in a cool, dry spot. The shelf life for eucalyptus oil is about six months. If refrigerated, it can last longer.

Transesterification (Base Catalyzed)

Transesterification process is carried out two times because coconut oil has high saturated fatty acids compared to other commonly used oils. Oil is pre-heated to 60-70^{0}C. 6.0 gm of KOH is added to 200 ml of Methanol and stirred KOH + Methanol mixture is added to the oil. Continue heating is continued at 60^{0}C for 2hrs and stirred at 1000 rpm Allowed to Settle for 24 hrs. Two different layers are formed at the end of each stage of the transesterification process. The top layer formed is pure coconut oil, and the bottom layer is glycerine and is separated and pure coconut oil is used for further stages.

Water Washing

In order to remove the traces of methanol left (if any) in the oil, water washing is done by transesterification process. The process of water washing is as follows, i) 500ml of water is taken into a bottle. ii) 1000ml of oil is added to it. Shake well for proper mixing of oil and water. Water and glycerine are separated after settling for 20 hrs. Again after water washing, two different layers are formed. The top layer is pure oil and the bottom layer is water wash separation. The bottom layer is removed and the pure oil obtained at the top is used.

Figure 1: Transesterification & Water Washing

Experimentation

A Computerized single cylinder, four strokes, constant speed, water cooled, direct injection, variable compression ratio diesel engine was used to study the performance, combustion and emission analysis. Specifications are as below.

Table 1: Test Engine Specifications

Parameter	Specifications
Model	Kirloskar VCR engine
Type	4Stroke,Single cylinder
Cooling System	Water Cooled
Bore diameter	80 mm
Stroke	56 mm
Compression	
	12:1 to 20:1
Ratio	
Rated Speed	1500 rpm
Rated Power	3.7 kW

Figure 2: Experimental Setup

RESULTS AND DISCUSSIONS

Varying the compression ratios at various loads on a VCR-CI Engine, performance and emission characteristics are to be determined when fuelled with Coconut oil and Eucalyptus oil blends and standard Diesel fuel. Three different percentages of blends of coconut & eucalyptus oil have been used as fuel. For (C90+E10) blend, 2% acetone additive is added. Each blend along with diesel has been tested at two compression ratios of 16:1and 18:1.

Brake Thermal Efficiency (BTE)

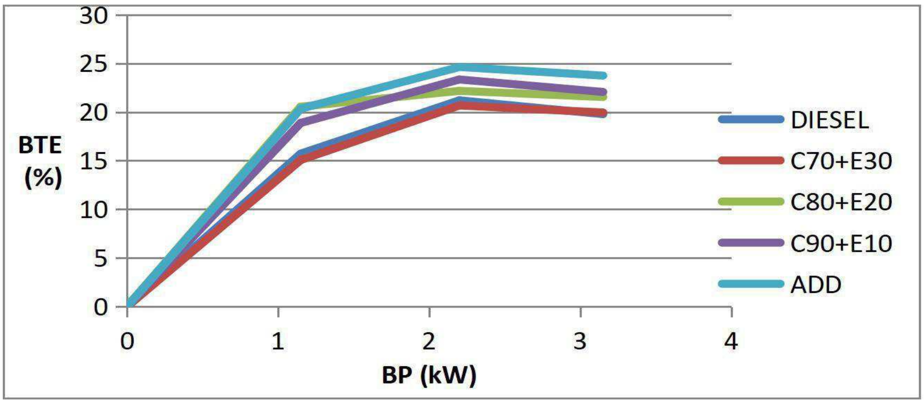

Figure 3: BP Vs. BTE for Diesel, C70+E30, C80+E20, C90+E10, C90+E10+ADD at CR 16:1

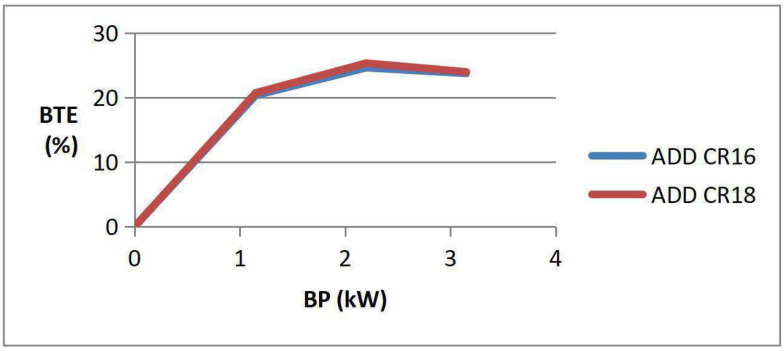

Figure 4: BP Vs. BTE for C90+E10+ADD at CR 16:1 and 18:1

Brake Specific Fuel Consumption (BSFC)

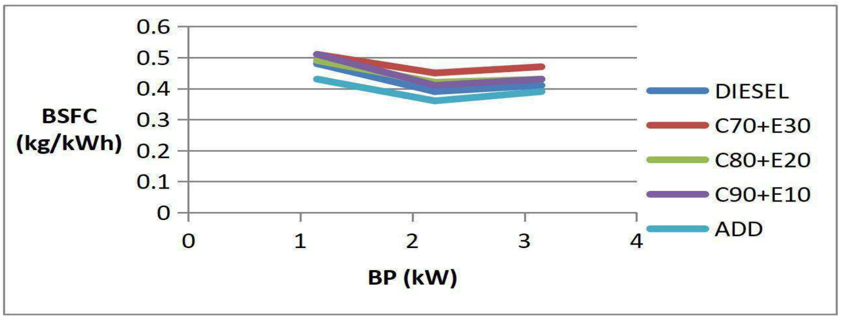

Figure 5: BP Vs BSFC for Diesel, C70+E30, C80+E20, C90+E10, C90+E10+ADD at CR 16.1

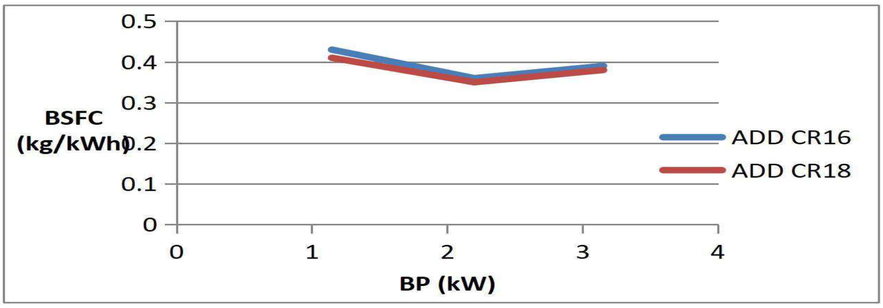

Figure 6: BP Vs BSFC for C90+E10+ADD at CR 16:1 and 18:1

Hydro Carbons (HC)

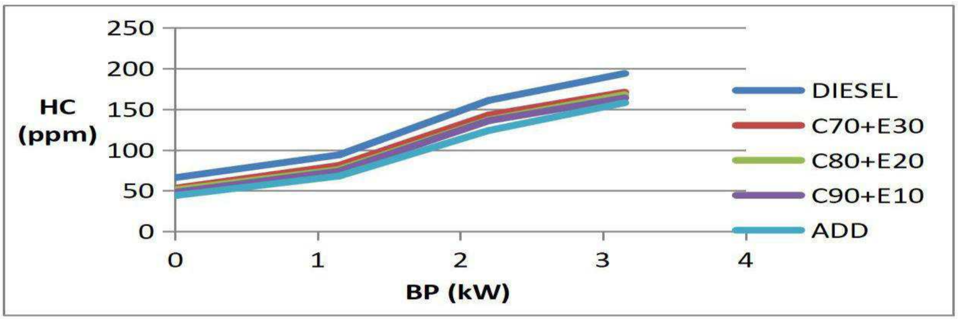

Figure 7: BP Vs HC for Diesel, C70+E30, C80+E20, C90+E10, C90+E10+ADD at CR 16:1

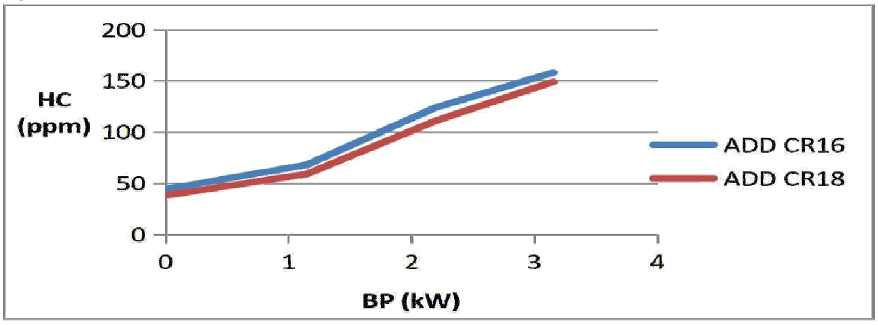

Figure 8: BP Vs HC for C90+E10+ADD at CR 16:1 and 18:1

Carbon Monoxide (CO)

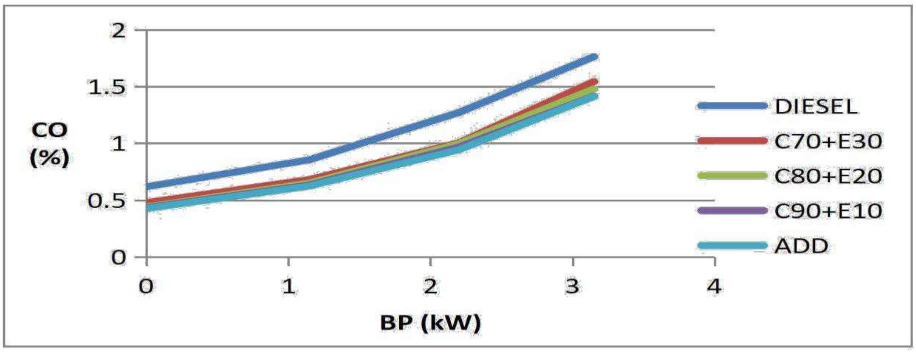

Figure 9: BP Vs CO for Diesel, C70+E30, C80+E20, C90+E10, C90+E10+ADD at CR 16:1

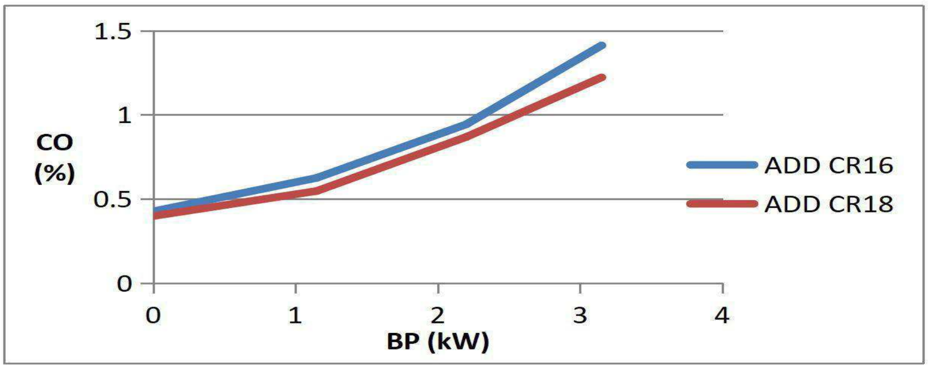

Figure 10: BP Vs. CO for C90+E10+ADD at CR 16:1 and 18:1

CONCLUSIONS

From the results of the experimentation, it is evident that both performance and emission characteristics show better results at higher compression ratios. Also, performance and emission characteristics show better results when coconut oil percentage is higher in the fuel blends. Addition of Acetone to the fuel increases the performance of the engine by enhancing heat release & also decreases HC & CO emissions slightly. (C90+E10+ADD) blend at 18 CR has shown better results compared to all other fuels and compression ratios. Thus, it can be concluded that Coconut oil-90% + Eucalyptus oil-10%, when added with 2% Acetone additive results, brake thermal efficiency 25.24%, brake specific fuel consumption 0.35 and emissions HC & CO are slight decreases can act as a complete replacement for diesel in CI engine with higher performance and lower emissions.

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